Available online www.jocpr.com

Journal of Chemical and Pharmaceutical Research, 2014, 6(4):1194-1197

Research Article

ISSN : 0975-7384
CODEN(USA) : JCPRC5

Biodiesel production using germinated maize seed oil

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ABSTRACT

In the present study the germinated maize seeds were dried and crushed in to powder and then the oil was extracted using alcohol. Transesterification of germinated maize seed oil was done by base catalyst like sodium methoxide. After the above reaction, distillation off excess alcohol is done to obtain crude biodiesel. Then washing was done using water to remove excess alcohol.

Key words: Germinated maize seeds, Transesterification, Biodiesel, Extraction.

INTRODUCTION

Environmental pollution and depleting supply of fossil fuels are the key factors leading to search for the alternative sources of energy. Consumption of fossil fuels have caused the harm to environment by increasing the emission of CO_2 concentration in the atmosphere [7]. 100% of the energy is needed in the transportation sector by fossil fuels [2]. In the transesterification of vegetable oils, a reaction between triglyceride and alcohol in the presence of a strong acid or base, producing a mixture of fatty acids alkyl esters and glycerol [8],[6]. The base-catalyzed transesterification of vegetable oils proceeds faster than the acid-catalyzed reaction [3],[4]. It is believed that major production of biodiesel from edible oils may bring global imbalance to the food supply and demand market [1].The non-edible vegetable oils such as *Madhuca indica, Jatropha curcas* and *Pongamia pinnata* are found to be suitable for biodiesel production [5],[6].

Bio diesel is an alternative diesel fuel prepared from renewable resources and is most popular as an alternative energy sources because it is non toxic and biodegradable. India has great potential for production of biodiesel from non-edible oil seeds[9]. Biodiesel consists of mono alkyl esters of long chain fatty acids, more commonly methyl esters and is typically made from biological resources such as plant seed oils, animal fats or even waste cooking oils by transesterification with methanol.[10]

EXPERIMENTAL SECTION

Steps for obtaining oil

Maize seeds were crushed to obtain powder. Alcohol was added to the powder and stored in a closed container to avoid evaporation. It was left overnight for the extraction of oil. The obtained oil is processed with base catalyst transesterification mechanism.

Transesterification

The transesterification experiments were performed in conical flasks using 250 g of all the extracted oil. The catalyst is typically sodium methoxide. It is dissolved in the alcohol using a standard agitator or mixer. It is added to the extracted oil .1.25 g (0.5% by weight of oil) of sodium methoxide. The catalyst was first dissolved in 72 g of ethanol which represented a 100% excess of the stoichiometric amount required for the transesterification.

Reaction

The alcohol/catalyst mixture is charged into a closed vessel and the oil or fat is added. The system from here on is totally closed to avoid the loss of alcohol. The reaction mix is kept just above the boiling point of the alcohol (around 160 °F) to speed up the reaction and the reaction takes place. It was necessary to heat the ethanol slightly with stirring to dissolve the catalyst completely. The ethanol and dissolved catalyst were then added to the oi1 and stirring was started. Recommended reaction time varies from 1 to 8 hours, and some systems recommend the reaction take place at room temperature.

Alcohol is normally added in excess to ensure the total conversion of the fat or oil to its esters. Care must be taken to monitor the amount of water and free fatty acids in the incoming oil or fat. If the free fatty acid level or water level is too high it may cause problems with the formation of soap. The reaction was arrested in the samples by adding one or two drops of water. The samples were analyzed to determine the degree of completion of the reaction.

Phase Separation

After the reaction is completed, two major products glycerin and biodiesel exists. Each has a substantial amount of the excess methanol that was used in the reaction. The reacted mixture is sometimes neutralized at this step if needed. The glycerin phase is much denser than biodiesel phase and the two can be gravity separated with glycerin simply drawn off the bottom of the settling vessel. In some cases, a centrifuge is used to separate the two materials faster. After 120 minutes of reaction time, the reaction was stopped and the reaction mixture was allowed to stand overnight while phase separations occurred. The ester phase was then decanted from the equilibrium mixture.

Alcohol Removal

Once the glycerin and biodiesel phases have been separated, the excess alcohol in each phase is removed with a flash evaporation process or by distillation. In others systems, the alcohol is removed and the mixture neutralized before the glycerin and esters have been separated. In either case, the alcohol is recovered using distillation equipment and is re-used. Care must be taken to ensure no water accumulates in the recovered alcohol stream.

Washing

Excess alcohol and residual catalyst were washed from the ester with water. The ester phase was placed in a glass column 1.26 cm in diameter and 100 cm in length. Water was sprayed into the top of the column at a low velocity. The excess alcohol and catalyst were removed by the water as it percolated through the column. During the washing, some of the ester formed an emulsion with the water; a time of 24-48 hours was required for the water phase containing alcohol, catalyst, and emulsified ester to settle and the ester phase to become clear.

RESULTS AND DISCUSSION

Oil Extraction

Oil was extracted from the maize seed by the addition of alcohol(Fig: 1). This is followed by Transesterification process.

Transesterification

This is the second step done after the Oil Extraction. Here it is done by the addition of base catalyst i.e., sodium methoxide. Once the base has been added it forms two layers. The top transparent layer, methyl ester and the bottom settled dark layer, Glycerin. Since the glycerin phase is heavier it settles at the bottom. This has to be washed out to obtain the methyl ester(Fig: 2).

Fig:1 maize seed oil

Phase Separation

Once the transesterification is completed the oils were allowed to settle down for 24 hrs so that the two phases separation is seen clearly. The Glycerin layer which has been settled at the bottom was separated out by the separation funnel. (Fig: 3)

Fig: 2 Oil after the addition of Base Catalyst

Fig: 3 Separation of two phases are carried out

Alcohol removal by washing

The separated Fatty acid methyl ester was taken beakers and was allowed for washing for the excess removal of alcohol. The water wash is performed by misting water over the biodiesel; water is heavier than biodiesel so it will settle to the bottom much as the glycerin did. As this water settles out it passes through the biodiesel and picks up impurities such as residual catalyst, excess methanol and soaps. Once the water settled it is drained. This wash technique should be repeated until rather clean and clear water is removed.(Fig:4,5,6,7)

When the water settles to the bottom of the tank not all of the water settles some will become in solution with the biodiesel this yields a very milky appearance to the fuel. The fuel should be dried by heating it and allowing it to circulate for a few hours within the tank.

Fig: 4 After the First wash

Fig: 5 After the second wash

Fig: 6 After the third wash

Fig: 7 After the last wash

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